TUMOUR REMISSION IN RATS BY IRRADIATION WITH NON-THERMAL POWER LEVELS MICROWAVES

George. Sajin(*), Teodor Sandulescu(**), Victoria Moraru(**), Maria Sajin(***)

(*) National Research Institute for Microtechnologies, Str. Erou Iancu Nicolae 32B, PO Box 38-160, 72996, Bucharest, Romania
(**) Oncological Institute of Bucharest, 252 Sos. Fundeni, 72425, Bucharest, Romania
(***) "Carol Davila" Medical University, Chair of Morphopathology, Spl. Independentei 99 – 101, Bucharest, Romania,

E-mail address: gsajin@imt.ro

Abstract: This work describes results for a non-conventional method to cure malignant tumours using microwaves with non-thermal power levels. A number of 25 rats were grafted with cancerigen cells. 10 from these animals were kept as controls and 15 were irradiated with microwaves in 7.5 GHz … 10.5 GHz frequency range and non-thermal power levels densities (less than 5 mW/cm^2). A total and definitive tumoral remission was ascertained for 12 irradiated rats; for 2 experience animals there was a tumoral recurrence and they died. All control animals died, maximum survival time being 34 days.

Introduction

The aim of this research is to find a non-conventional method to cure malignant tumours using microwave fields at athermal power levels. It is possible to consider hypothesis that animals and tumours are a compact resonance assembly, which changes in time. By microwave irradiation the entropy was adjusted to normal level allowing animal healing.

Microwave experimental set-up

Microwave set-up for experimental rats irradiation is shown in Fig. 1. It comprises a manual tuning microwave generator (1) in 7,5 GHz ... 10,5 GHz frequency range and power level possibilities up to 100 mW. A variable attenuator (2) is used for incident power adjustment and a -10 dB directional coupler (3) is used for power level and frequency measurements with the aid of a microwave wattmeter (10) and frequency meter (11). Two identical 75×52 mm^2 aperture horn antennas, (4) and (6), were used as microwave applicators. Their dimensions were as close as possible with the dimensions of the rats. The propagation mode was TE_{10} the electric field components being normal to the wide side of the aperture, with maximum intensity in the centre. Rat restrainer (5) that maintains the animal in microwave field emitted by horn antenna (4), was made in polystyrene bars (transparent at electromagnetic fields). The restrainer dimensions are fitted both with the rat and with the applicators apertures dimensions. To adapt receiving antenna to microwave characteristic impedance a tuning section (7) was added. A -20 dB directional detector (8) provide a signal for a digital millimetre (12) and (optionally) for an X - Y plotter. The digital multimeter (12) measure power level of emergent signal on the opposite side of the animal. A 2 W matched termination (9) was used to prevent reflexions that may affect measurements accuracy.

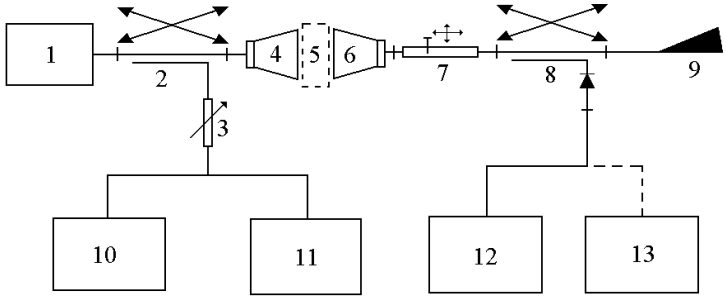

Fig. 1. Experimental set-up.

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Abstract

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Table 1: Experimental results: evolution of tumour dimensions in irradiated rats (IR) compared with controls (CR) and constrained controls (CCR)

Day	Tumoral volume (cm^3)												
	Experiment I		Experiment II			Experiment III							
	IR	CR	IR	CCR	CR	IR1	IR2	IR3	IR4	IR5	IR6	CCR	CR
7						2.37	2.58	2.46					
8			2.75	3.69	3.70	2.68	2.43	2.49	2.59	2.68	2.68	2.70	2.40
9			2.72	3.79	3.56	2.43	2.49	2.43	2.36	2.68	2.58	2.43	2.11
10			3.15	3.63	3.81								
11													
12						2.76	2.74	2.58	2.49	3.75	2.58	3.22	3.56
13	2.12		2.68	3.78	3.96	2.76	2.77	2.65	2.38	D	2.80	3.68	3.51
14	2.59		3.19	3.66	4.20	2.74	2.63	2.68	2.76	D	2.68	3.87	4.00
15	2.85		2.91	3.62	4.10	2.71	2.61	2.71	2.68	D	3.00	3.87	3.96
16	2.46		2.71	3.62	4.28	2.79	2.55	2.62	2.86	D	2.97	4.12	4.24
17			2.74	3.94	4.24								D
18													D
19	2.48					2.76	2.58	2.19	2.11	D	2.51	4.24	D
20	2.33		2.37	4.17	4.24	3.56	(*)	0	0	D	(**)	4.46	D
21	2.44	3.81	2.43	4.07	4.27	2.58		0	0	D	(**)	D	D
22	2.40	3.66	2.58	4.19	D	2.64		0	0	D	2.36 (**)	D	D
23	2.40		2.48	4.29	D		2.66	0	0	D	2.00 (**)	D	D
24			2.44	4.5	D		2.36	0	0	D	2.00 (**)	D	D
25					D	0	2.36	0	0	D	2.00 (**)	D	D
26	2.65	3.92			D	0	2.36	0	0	D	2.00 (**)	D	D
27	2.64	4.18	2.48	4.31	D	0	2.36	0	0	D	0	D	D
28	2.30	4.20	2.90	4.48	D	0	2.36	0	0	D	0	D	D
29	1.84	4.34	2.44	D	D	0	2.36	0	0	D	0	D	D
30	1.84	4.38	2.44	D	D	0	2.36	0	0	D	0	D	D
31			2.44	D	D	0	2.30	0	0	D	0	D	D
32	1.14	4.66		D	D	0	2.25	0	0	D	0	D	D
33	0	D		D	D	0	2.20	0	0	D	0	D	D
34	0	D	2.00	D	D	(*)	2.00	0	0	D	0	D	D
35	0	D		D	D		2.00	0	0	D	0	D	D
36	0	D		D	D		2.00	0	0	D	0	D	D
37	0	D	0	D	D		2.00	0	0	D	0	D	D
38	0	D	0	D	D		2.00	0	0	D	0	D	D
39	0	D	0	D	D		0	0	0	D	0	D	D
40	0	D	0	D	D		0	0	0	D	0	D	D
41	0	D	0	D	D		0	0	0	D	0	D	D
42	0	D	0	D	D		0	0	0	D	0	D	D
43	0	D	0	D	D	3.03	0	0	0	D	0	D	D
44	0	D	0	D	D	D	0	0	0	D	0	D	D
45	0	D	0	D	D	D	0	0	0	D	0	D	D

Table 1 (cont): Experimental results: evolution of tumour dimensions in irradiated rats (IR) compared with controls (CR) and constrained controls (CCR)

Day	Tumoral volume (cm^3)											
	Experiment IV		Experiment V			Experiment VI						
	IR	CR	IR	CCR	CR	IR1	IR2	IR3	IR4	IR5	CCR	CR
7						2.68	2.90	2.60	2.40	2.30	2.60	2.40
8			3.75	3.50	3.70	2.68	2.42	2.64	2.46	2.40	2.70	2.40
9			2.75	3.50	3.75	2.72	2.50	2.75	2.50	2.60	2.80	2.70
10			2.85	3.60	3.80							
11												
12						2,76	2.65	3.00	2.52	2.60	3.22	3.50
13	2.12	2.40	2.90	3.60	4.05	2.76	2.80	3.00	2.60	2.80	3.70	3.50
14	2.60	2.70	2.90	3.60	4.35	2.72	2.68	3.00	2.50	2.70	3.90	4.00
15	2.95	3.00	2.90	3.70	4.35	2.70	2.60	3.00	2.52	2.70	3.90	4.00
16	2.85	3.20	2.71	3.80	4.35	2.70	2.55	3.00	2.55	2.08	4.10	4.20
17			2.78	3.85	4.35							
18												
19	2.80	3.40				2.60	2.20	2.10	2.10	1.20 (***)	4.24	4.24
20	2.75	3.80	2.54	4.05	4.35	2.50	(*)	(***)	(***)	(***)	4.46	4.24
21	2.44	3.81	2.50	4.10	4.35	2.30			(***)	(**)	4.46	D
22	2.40	3.92	2.40	4.20	D	2.10			0	(**)	4.50	D
23	2.40	3.92	2.30	4.30	D	0	2.06 (***)		0	(**)	D	D
24			2.25	4.50	D	0	2.36	(***)	0	(**)	D	D
25					D	0	2.36	0	0	(**)	D	D
26	2.65	3.92			D	0		0	0	(**)	D	D
27	2.65	4.17	2.10	4.50	D	0		0	0	0	D	D
28	2.30	4.20	2.00	4.50	D	0		0	0	0	D	D
29	1.84	4.04	1.90	4.50	D	(***)	(***)	0	0	0	D	D
30	1.84	4.40	1.80	4.50	D			0	0	0	D	D
31			1.76	D	D			0	0	0	D	D
32				D	D			0	0	0	D	D
33	1.14 (***)	4.66		D	D	(***)	(***)	0	0	0	D	D
34	1.14	D	1.65	D	D			0	0	0	D	D
35		D	(***)	D	D			0	0	0	D	D
36		D		D	D			0	0	0	D	D
37		D		D	D			0	0	0	D	D
38		D		D	D	(***)	(***)	0	0	0	D	D
39		D		D	D			0	0	0	D	D
40	0	D	(***)	D	D			0	0	0	D	D
41	0	D		D	D			0	0	0	D	D
42	0	D		D	D	(***)	(***)	0	0	0	D	D
43	0	D		D	D	3.30	0	0	0	0	D	D
...	...	...	...	...	...	...	...	...	...	...	...	...
53	0	D	0	D	D	D	0	0	0	0	D	D

In the previous tables, the following notations were used: Day = day of irradiation treatment; IR = irradiated rat; CR = control rat; CCR = constrained control rat (animal permanently restrained in a box to test contention stress); D = death of the rat; (*) = surgical removal of an inguinal nodule; (**) = formation and persistence of a crust over the tumour; (***) = formation (and persistence) of a nodule.

Experimental methods

A number of 25 WISTAR rats were inoculated with Walker 256 cancerigen cells. When the induced tumours were about 850 ... 1000 mm^3, 10 from these animals were kept as controls and 15 animals were irradiated with microwaves in 7.5 GHz ... 10.5 GHz frequency range. Microwave power level at the generator output was under 5 mW so that, having in view animal geometry and dimensions and experimental set-up, power density on the whole animal body was always at non-thermal levels. For each irradiating session the microwave frequency and power level were carefully chosen for each rat (and also different from an irradiating session to another one for the same animal) to have a resonance in power absorption (measured as resonance of transmitted microwave signal through the animal, received by the antenna 6 - see Fig. 1). The irradiation session was interrupted when the power absorption in the animal body become constant (about 10 min). There were about 25 ... 40 irradiation sessions for each experience animal, depending on tumoral evolution.

Results and comments.

There were 6 experimental runs. Results are concentrated in Table 1, parts I and II. In the first column of each part of the table there are the day from the beginning of microwave irradiation.

First experiment. Two rats were used: a control one and an irradiated one. Tumour of the irradiated animal shows a dimensional reduction trend and was totally eliminated in day 33. The control rat died in day 33.

Second experiment. Three rats were used: one was irradiated with microwaves, one was used as contention control (to test contention stress) and one was used as a simple control. For the irradiated rat the tumour elimination was ascertained in day 37; both the controls died in days 28 and 21, respectively.

Third experiment. Eight rats were used: six animals were irradiated, one was used as contention control and one was used as a simple control. For three irradiated rats it was tumoral remissions in the days 38, 19 and 19, respectively. The fourth irradiated rat died accidentally in day 13 without any connexion with our experiment. The fifth irradiated animal formed a crust over the tumour surface. The tumour and the crust were eliminated in the day 27. Finally, the sixth irradiated rat demonstrates, initially a tumoral remission in day 25. After few days, an inguinal nodule appeared, that was surgically removed in day 34. Then was a rapid tumoral development and the animal died in day 44.

Both the constrained and not-constrained control rats died in days 21 and 17, respectively.

Fourth experiment was similar with first experiment. Two rats were used: one control and one irradiated. Tumour of the irradiated animal shows a dimensional reduction trend. In the day 33 it was ascertained a nodule formation that was totally eliminated in about 8 days. The control rat died in day 34.

Fifth experiment was similar with second experiment. Three rats were used: irradiated, contention control and simple control. The irradiated rat shows a continuous reduction trend of tumoral dimension. In day 29 a nodule formation was ascertained followed by total remission in day 53. Both the controls died in days 31 and 22, respectively.

Sixth experiment. Seven rats were used: Five animals were irradiated, one was used as contention control and one was used as a simple control. Three irradiated animals formed nodules continued by total remission in the days, respectively, 43, 25, and 22. In one case, formation of a crust was ascertained, continued with remission in day 27. One of the irradiated rats demonstrates, initially a tumoral remission in day 23. After few days, a nodule appeared continued by a subsequent tumoral development and death of the animal in day 50. Both the constrained and not-constrained control rats died in days 23 and 21, respectively.

Conclusions

Six experiments were realized, using 25 rats grafted with tumoral cells. 10 rats were kept as simple controls (6) and constrained controls (4) and 15 rats were irradiated with microwaves with different frequencies in 7,5 GHz ... 10,5 GHz range and variable non-thermal power levels.

All the control animals died, the maximum survival time being 34 days from the experiment start (day from microwave irradiation beginning).

From 15 irradiated animals 12 demonstrated a definitive tumoral remission. Six months after the experiment they were alive and capable of reproduction (one of the irradiated rats was a pregnant female that born healthy little rats). For 2 experience animals there was a tumoral recurrence and they died after 44 and 50 days, respectively and one irradiated rat died accidentally.

As final conclusion, it is possible to consider hypothesis that animals and tumours are a compact resonance assembly. By proper choice of microwave irradiation conditions for each rat, the entropy was adjusted to normal level allowing animal healing.